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Improvements in Project Management Computer Programs

The idea is to take techniques used in the field of scientific data visualization (also known as scientific visualization) and apply them when displaying project management information.

Visualization can be defined either as "Visualization is the use of computer-generated media based on data in the service of human insight/learning" (Analytic Graphics - Carol Hunter), or "Visualization is the use of computer imagery to gain insight into complex phenomena" (quote from the computer bulletin board service comp.graphics.visualization).

Project management is concerned with the planning, day to day control and assessment of projects in terms of tasks, resources and timescales. Project management information is usually displayed as charts or tables, for example a Schedule Chart (also known as a PERT Chart), a Resource Timeline Chart, a Task Timeline Chart and a Trend Chart. All these four charts are two dimensional (2D). These charts in the past were hand drawn but are now mostly produced by computers. There are several companies that supply computer systems or software for generating, displaying and/or manipulating these charts. However, the initial information from which the charts are generated, for example how long a task will take, is provided by skilled or experienced people.

Scientific visualization is concerned with displaying scientific/engineering data through the use of computer systems. This data can be 2D but is usually three dimensional (3D). An example of such will be found in the April 1990 issue of Supercomputing Review on page 24. The data can be produced by data acquisition (e.g. from sensors on a satellite), or as the result of simulating some

scientific phenomena or environment. It is not merely through the addition of an extra dimension that value is gained, but in the way that the data is displayed. Instead of having pages of printed numbers, or 2D graphs, a scientist can have displayed a 3D colour shaded picture in perspective of, say, the noise frequencies of a jet engine, as if the noise were a tangible, sculptured object. 3D computer graphics techniques such as perspective, shading, transparency, depth cueing, rotation, fly-through, zooming, level of detail management, texture mapping and animation can be applied. These techniques are described in standard 3D computer graphics text books such as "Computer Graphics Principles and Practice" by Foley, van Dam, Feiner and Hughes, Second Edition, published by Addison Wesley. With these techniques a 'virtual environment' can be created for fly-through or to emphasise salient aspects of the data. Scientific visualization enables rapid understanding of complex data. By viewing the data in a different representation, the scientist can achieve an intuitive understanding of the problem being studied.

Engineering visualization uses the same techniques as scientific visualization and often similarly obtained data. However, engineering visualization is usually concerned with tangible objects e.g. a motor engine or apartment block.

Scientific and engineering visualization are concerned with displaying sensed data, scientifically formulated data or measured data. Project management charts are a 2D representation of a project plan. As such they do not contain 'data' but just as writing is a symbolic representation of the spoken word, these charts symbolically represent the thoughts and estimates of the planner.

In accordance with the present invention, a project management computer program has a three dimensional visualization technique.

Suitably, the visualization technique is either scientific or engineering visualization, and computer graphic techniques such as perspective, shading, transparency, depth cueing, rotation, fly-through zooming, level of detail management, texture mapping and/or animation, are provided.

Preferably, the program provides colour and/or texture and/or animated shaded representations in perspective.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a single frame of a computer generated project visualization animation in accordance with the present invention;

Figure 2 shows a Schedule Chart in accordance with the prior art;

Figure 3 shows the zoom back feature for a Timeline Chart using 3D visualization techniques in accordance with the invention; and

Figure 4 shows the zoom forward feature into a sub-project within a Schedule Chart using 3D visualization techniques in accordance with the invention.

The project management computer program with three dimensional visualization techniques is preferably run on a 486 or Pentuim processor based personal computer and written in 'C' with calls to the OpenGL graphic library. This library is supplied with Windows NT and is bundled with Windows 95, and is available for most UNIX workstations.

Suitably, a 3D graphic accelerator (e.g. one using a 3Dlabs GLINT chip) is installed, and a 3D graphics language such as RealityLab, RenderWare or BRender is used to provide high resolutions (e.g. 1024 x 768) and plenty of colours (e.g. 32768).

Figure 1, though hand drawn, attempts to show what a single frame of a computer generated project visualization animation may look like. The diagram shows the effect of applying some visualization techniques to the same information shown in a corresponding Schedule Chart as shown in Figure 2. In particular, the effects of lighting and shading will be noted from Figure 1.

3D computer graphics techniques that would be applicable to project visualization are listed below. The following uses the term 'primitive' to refer to a point, line, polygon or any other drawable geometric shape including text characters and bi-cubic patches:

Hidden surface removal, visible surface determination and depth testing: a 3D model or object is defined with a specified depth value at each vertex. Parts of or whole objects that would be obscured by others whose depth indicates that they are nearer, do not get drawn. Several techniques are available to achieve this such as Z buffering and depth sorting.

Back-face culling: an optimization to hidden surface removal so that primitives facing away from the viewer are rejected prior to depth testing.

Clipping and scissoring: these are techniques whereby only parts of objects get drawn. These are applicable to 2D computer graphics but are relevant here when the object is a 3D entity.

Perspective: objects can be drawn with perspective i.e. those object or parts that are intended to be further from the viewer than others are drawn smaller than they otherwise would be.

Animation: the ability to show movement within a 3D environment by drawing image after image (or frames) where each frame is slightly changed from the previous one.

Double buffering: this technique helps provide smooth animation between successive 'frames' of computer graphics.

Colour shading: the ability to draw a primitive whereby the colour changes continually across it's surface. Gouraud and Phong shading are typical examples of this technique.

Transparency, translucency and Opacity: the use of techniques such as alpha blending to draw primitives with constant or varying degrees of opacity.

Pattern filling: the ability to draw a line or filled polygon whereby the colour changes across it's surface in steps to produce a pattern. This is applicable to 2D computer graphics but it is relevant here when the object is a 3D entity.

Lighting: the ability to define coloured light sources and to use shading to imply that light is shining on or away from objects.

Shadows: the ability to draw shadows as a result of light sources.

Fogging/Depth cueing: this technique allows the general colour of a scene to change with distance. It my be used to emphasise distance or to introduce fog into a scene etc.

Antialiasing: this technique minimizes the effect of jagged edges when a primitive is neither horizontal or vertical with respect to the screen.

Modeling and projection transformations: these allow the position in 3D space of the viewer to change with respect to the object scene or vice versa.

Zoom: the ability, often through the use of transformations, for the viewer to apparently zoom closer to or further away from an object by drawing it larger or smaller.

Panning: the ability, often through the use of transformations, to apparently view further up or down, to the left or right of a scene.

Level-of-detail management: this technique reduces the amount of detail in the scene usually to increase animation rates. Typically, small details are omitted from objects that are positioned in the distance.

Texture, bump and reflection mapping: these techniques allow primitives to be given a particular texture or finish e.g. marble or chrome.

Accumulation buffering: this technique allows higher quality antialiasing and special effects such as motion blur.

Morphing: though not specifically a 3D graphics technique, this can be applied to scenes containing 3D objects. This technique allows controlled change of an object from one form to another.

Picking: this is a technique whereby drawn objects can be selected on the screen, usually by depressing a mouse button. This is relevant here when the object is a 3D entity.

Solid modeling: most of the above refer to surface modeling where 3D objects are purely represented by their surfaces and are effectively hollow. However, many of the above techniques are relevant to solid modeling.

The combination of visualization techniques to the field of project management will have a number of benefits, e.g.:

a.) the 3rd dimension and/or transparency will allow sub-projects to be displayed along with main projects (see Figure 3) avoiding the need for the user to open separate files containing sub-project charts. The 3 frames shown in Figure 3 are taken from a zoom sequence. The user apparently flies backwards allowing the whole of the chart to be seen (bottom frame). The ability to zoom allows large projects to be

handled without splitting the chart into separate files. Note the use of lighting and shadow on the first frame;

b.) the 3rd dimension will allow earlier or different versions of project charts to be displayed simultaneously along with current versions of projects. The optional use of depth cueing/fogging will enable the user to de-emphasise project charts drawn in the distance to avoid cluttering the view;

c.) the 3rd dimension will allow multiple charts for different projects to be displayed simultaneously in different areas of the 3D environment. Again, the optional use of depth cueing/fogging will enable the user to de-emphasise project charts drawn in the distance to avoid cluttering the view;

d.) the 3rd dimension will ease connection routing problems between tasks when displayed as a Schedule or PERT Chart. This can be achieved by positioning task boxes further back or further forward than others so that the connecting lines or arrows do not intersect other nearby tasks (see Figure 1);

e.) the use of zooming, panning, and fly-throughs will permit whole projects to be grasped more easily (see Figure 4). The 3 frames in Figure 4 are taken from a zoom sequence of a 3D version of diagram 2. As the user flies forward towards the 'Produce Plastic Trays' subproject box, the door apparently lifts up to allow the user to fly in. Inside the user finds a 3D representation of the subproject. Note in frame 10 that the door is translucent. Techniques such as this allow

the user to fly into subprojects within subprojects without opening new files;

f.) information can be interpreted quicker and more easily by being represented through the application of textures (e.g. wood grain, marble etc.) and a greater range of colours;

g.) important information can be more strongly emphasised through the application of surface texture and/or a greater range of colours. For example the colours with greater intensity may be used to indicate a critical path through a project;

h.) distant information can still be made visible by using translucency or transparency with foreground objects;

i.) smoother edges to drawn projects can be produced through the use of antialiasing;

j.) the use of the above techniques will create a virtual non-reality. Like virtual reality systems, the visual effects will give a sense of immersion into another environment. Unlike virtual reality, the objects being viewed will not have a physical counterpart in the real world;

k.) the use of lighting, shading, and shadows will help orientate the user within the 3D project management environment;

l.) as well as speeding up fly-throughs and animation sequences, the use of level-of-detail management will help prevent the user being overloaded with information when a large amount of information is effectively viewed from afar (see Figure 4);

m.) the use of morphing will help demonstrate changes. For example, an animation sequence could be arranged to show how a project chart changed from one state to another. The careful use of morphing to gradually change one chart into the other would highlight where in the chart or when the significant changes occurred; and

n.) use of picking will help in the generation of 3D project management charts as it does for 2D chart generation.

Some of the other advantages of 3D computer graphics in project management are:

i.) an easing of the interconnection problem for Schedule/PERT Charts due to arrows and task boxes being given depth and optionally shadows;

ii.) the use of zooming and fly-throughs allow large projects to be grasped more easily;

iii.) there is no need to open and close separate files for sub-projects. The user just flies into the appropriate task boxes;

iv.) multiple projects or old versions of charts can be displayed simultaneously;

v.) the use of fading by distance (depth cueing/fogging) avoids cluttering;

vi.) use of the third dimension to show other information such as project trends;

vii.) greater use of colour and translucency to give greater emphasis to important information; and

viii.) increased realism (really virtual un-realism) creating a sense of immersion in the project world.

Project management visualization techniques may be applied to all existing forms of project management chartS e.g. Schedule Charts (also known as PERT Charts), Resource Timeline Charts, Task Timeline Charts and Trend Charts . Alternatively, due to the added dimension, information from two different charts may be combined. For example, a single 3D project visualization could contain information represented by a Timeline Chart using the height and width co-ordinates, and a Trend Chart using the width and depth co-ordinates.

There are two approaches to project management visualization. The first as already described takes basically flat charts which have depth but are recognizably similar to the 2D form. The second approach occurs when the chart takes a more complex 3D form such as circle, spiral, or cube. This second methodology can allow greater visibility to information and ease of movement within the 3D scene.

Project management visualization is applicable at two stages of the project management process. Firstly, during development, the user could interactively create 3D charts in a similar way to 2D charts using menu selection, dragging, and picking etc., but now with 3D objects. Positioning of objects would need to be extended to take consideration of the third dimension. Secondly, project management visualization is also valuable to present completed charts to others. This could either be in a form whereby the user interactively chose the fly-through route, or in a pre-recorded form whereby the user has previously created particular animation sequences.

The project management computer program is used in an apparatus adapted and arranged for project management, the apparatus (e.g. a computer) comprising a central processing unit, storing means for the program, accessing means for the program, processing means for the program, selecting means for different portions of the program, and display means (e.g. a computer screen) for the visualizations.

In conclusion, the application of scientific visualization techniques to the field of project management results in significant improvements in conveying information to the user.

CLAIMS

1. A project management computer program having a three dimensional visualization technique.

2. A program as claimed in claim 1 wherein the visualization technique is either scientific visualization or engineering visualization.

3. A program as claimed in either claim 1 or 2 wherein computer graphic techniques are provided.

4. A program as claimed in claim 3 wherein the graphic techniques include perspective, shading, transparency, depth cueing, rotation, fly-through zooming, level of detail management, texture mapping and/or animation.

5. A program as claimed in any preceding claim wherein colour and/or texture and/or animated shaded representations in perspective are provided.

6. Use of the computer program as claimed in any preceding claim.

7. A computer in combination with the computer program as claimed in any one of claims 1 to 5.

8. A method of operating a computer according to the computer program as claimed in any one of claims 1 to 5.

9. A computer as operated by the computer program as claimed in any one of claims 1 to 5.

10. An apparatus adapted and arranged for project management, the apparatus comprising a central processing unit and using the computer program as claimed in any one of claims 1 to 5.

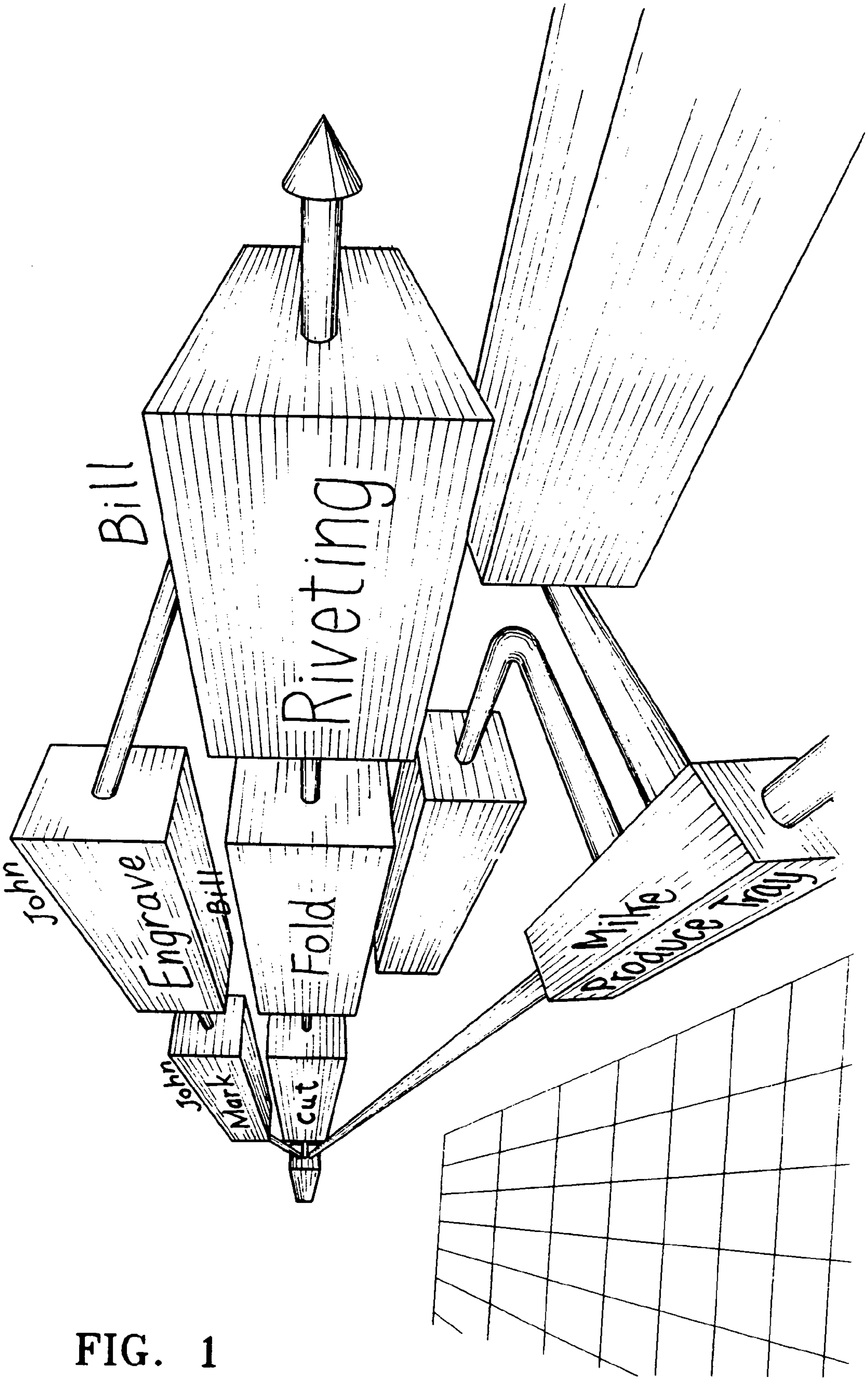

Bill
Riveting
John
Engrave
Bill
Fold
John
Mark
Cut
Mike
Produce Tray

FIG. 1

2/4

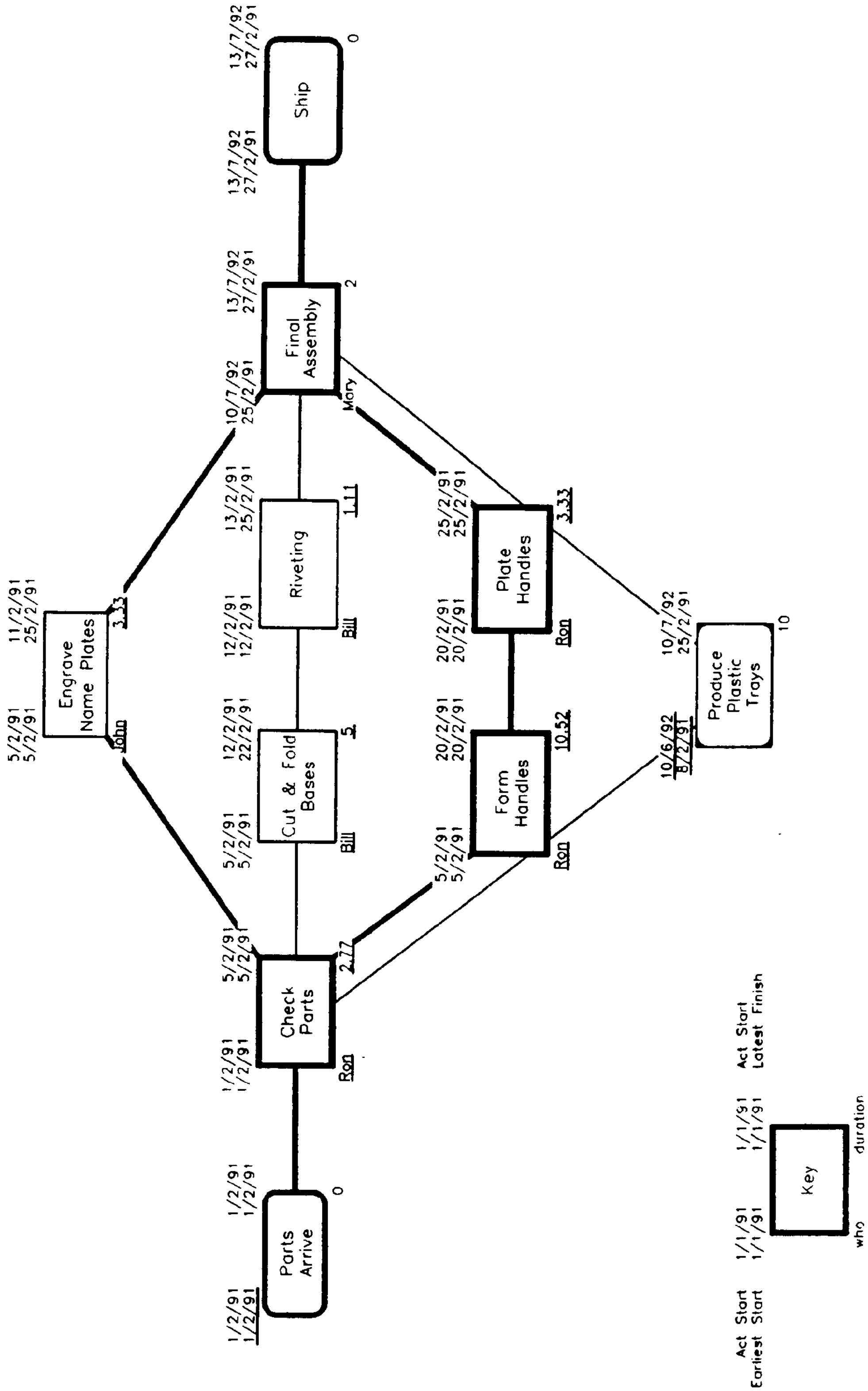
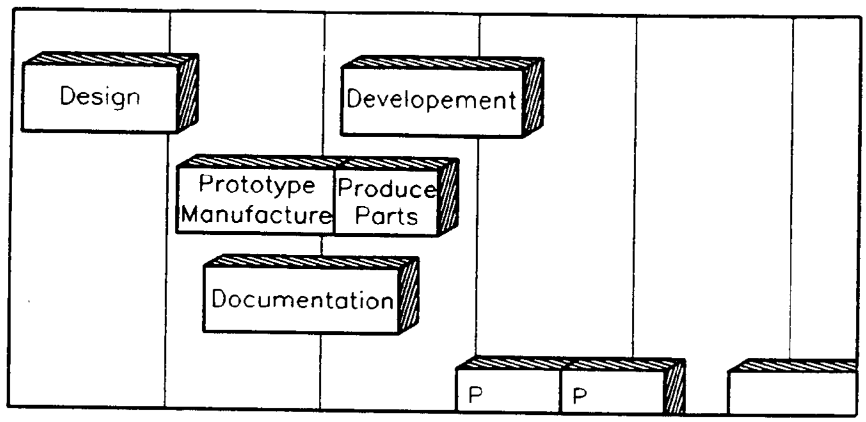
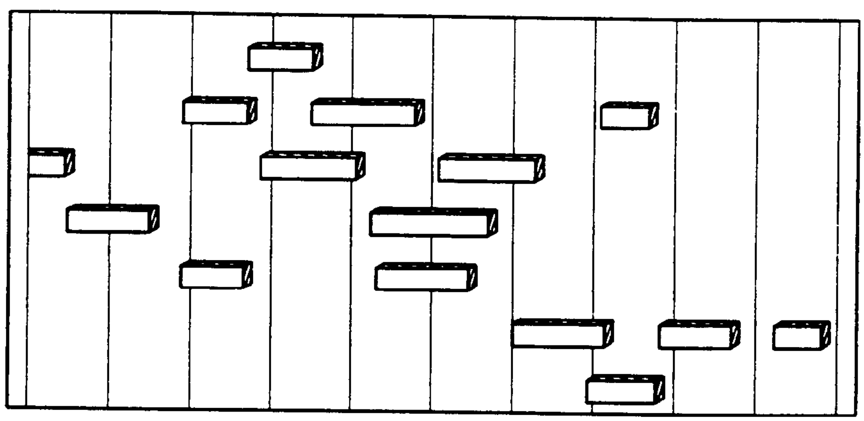

Parts Arrive
Check Parts
Engrave Name Plates
Cut & Fold Bases
Riveting
Form Handles
Plate Handles
Produce Plastic Trays
Final Assembly
Ship
John
Bill
Ron
Mary
Key
who
duration
Act Start
Earliest Start
Act Start
Latest Finish

FIG. 2



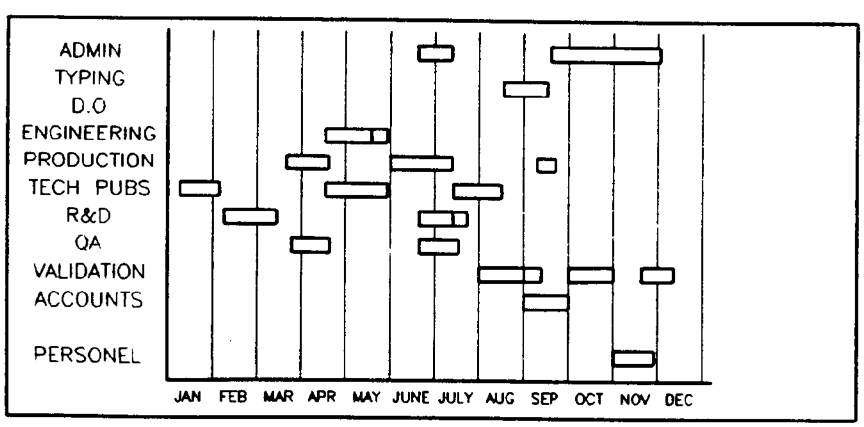
frame 1

FIG. 3a



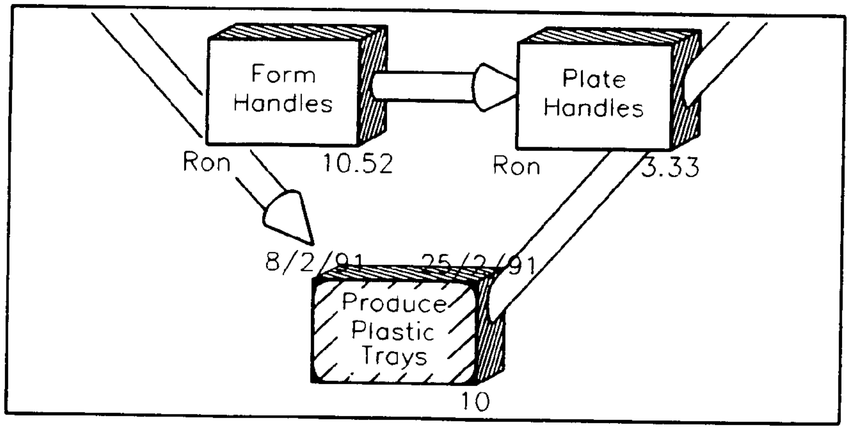
frame 10

FIG. 3b



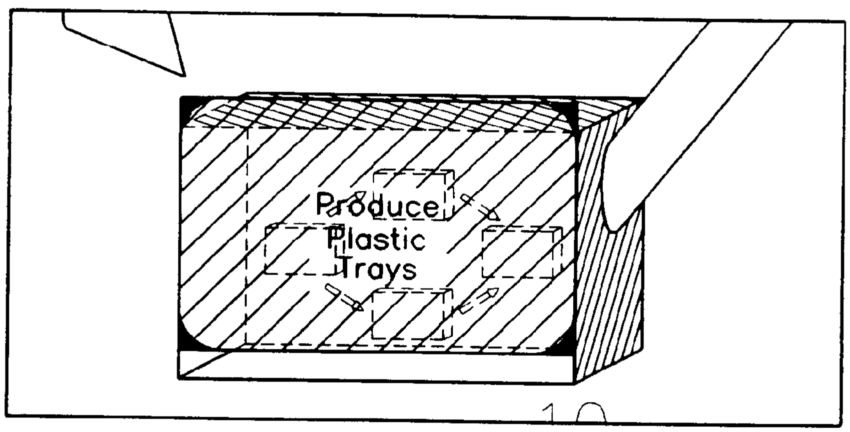
frame 20

FIG. 3c



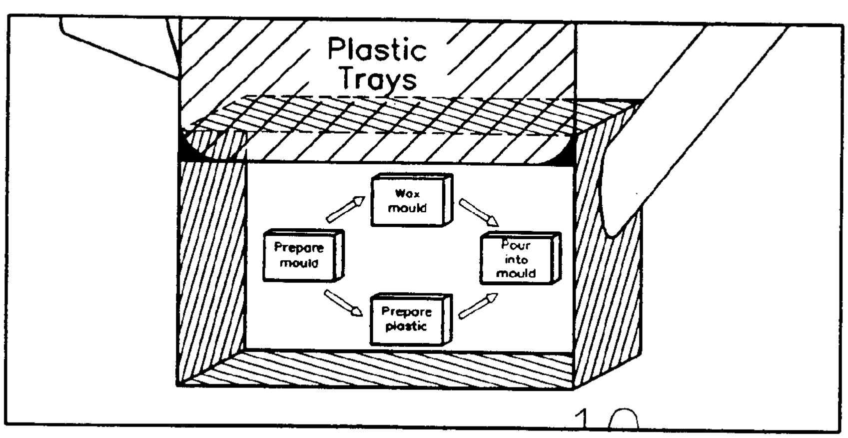
frame 1

FIG. 4a



frame 10

FIG. 4b



frame 20

FIG. 4c